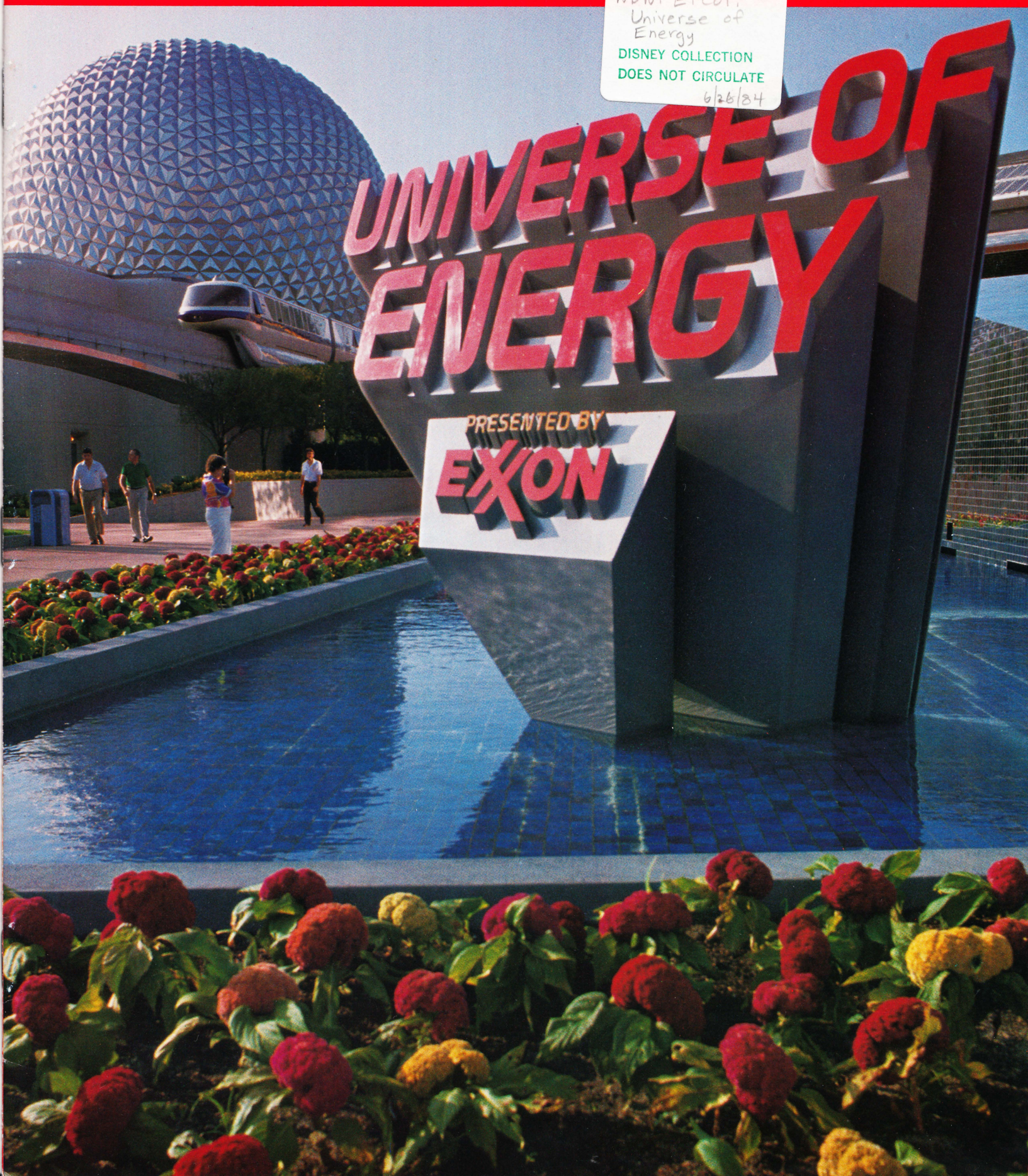
A Classroom Guide
to the EPCOT Center Experience

UNIVERSE OF ENERGY

Presented by EXXON



EPCOT Center: A Definition

Welcome to EPCOT Center, the Experimental Prototype Community of Tomorrow. Walt Disney chose this name to describe what has become the realization of his greatest dream. He visualized EPCOT Center as a project that "will never be completed but will always be introducing, testing, and demonstrating new materials and new systems . . . a showcase to the world for the ingenuity and imagination of American free enterprise." But unlike most Utopian visions, EPCOT Center is real: here the future is something to see, hear, smell, touch and taste and wonder about.

There are two parts to EPCOT Center: Future World and World Showcase. In the Disney tradition of master storytelling, Future World demonstrates the dazzling technology of the years to come. World Showcase highlights the present and its most vital resource: people. World Showcase illustrates life around the world with such realism that visitors may well feel transported to the countries represented. Both parts of EPCOT Center work together to create a "permanent (showcase) of imagination and discovery, education and exploration . . ."

A Commitment to Education

EPCOT Center combines the Disney expertise in entertainment and communication with a compendium of information from the academic world, industry, and government. The primary goal of this combination is to provide visitors with an exceptional educational experience that *inspires them to actively participate in the shaping of the future*. In classrooms each day teachers try to achieve this same goal. For this reason, teachers, our most important guides to the future, are considered very special guests at EPCOT Center.

A Field Trip with a Long Memory

Teachers often enrich the curriculum by bringing to it the immediacy of their own experiences. Sharing snapshots and souvenirs is one way of transferring the excitement of travel to a classroom. But EPCOT Center is much more than a sightseeing destination. The discerning educator can stretch an EPCOT Center visit into a functional and lasting part of a curriculum. This Teacher's Guide is designed to help educators tap the vast informational resources of EPCOT Center and put them into a meaningful academic context. Filled with practical, easy-to-use materials and ideas for immediate classroom use, this guide serves as a "take-home" field trip to EPCOT Center!

How to Use this Guide

To assist teachers in a variety of learning situations, the materials in this guide have been divided into three instructional levels. For convenience these levels are highlighted with different colors. The levels and color codes are as follows:

Level A (Grades 3-6)	Pages 2-4	RED
Level B (Grades 7-9)	Pages 5-8	BLUE
Level C (Grades 10-12)	Pages 9-12	GOLD

Almost everything needed for a complete lesson is included. Each level is composed of three parts:

1) Instant Lesson Plan

It is "instant" because very little prior preparation is necessary. Each lesson plan provides specific learning objectives, brief teacher directions, and answers to the corresponding reproducible worksheets. Suggested follow-up activities are also included. These ideas will help teachers who choose to cover these educational ideas in greater detail. Designed to be flexible, these suggestions can be applied to math, language arts, computer literacy, or other subject areas.

2) Reading Experience

This is a reproducible sheet that gives students a brief summary of the educational content of *Universe of Energy*. The vocabulary and concepts are appropriate to each instructional level.

3) Follow-Up Worksheet

This reproducible page features questions and activities that review the reading material and provide practice in basic reading comprehension skills, such as recalling facts, sequencing, inference, and prediction.

BEFORE YOU START . . .

Before the lesson begins, you may want to describe your own experience at EPCOT Center. This not only personalizes *Universe of Energy*; it also gives you a chance to share photos and souvenirs! The subject area specialists and classroom teachers who have contributed to this and other EPCOT Center educational materials hope that this Teacher's Guide will be among the most useful of your mementoes of EPCOT Center.

OBJECTIVES

To define energy
To provide background information on fossil fuels
To give examples of future alternate energy sources
To provide practice in reading comprehension skills

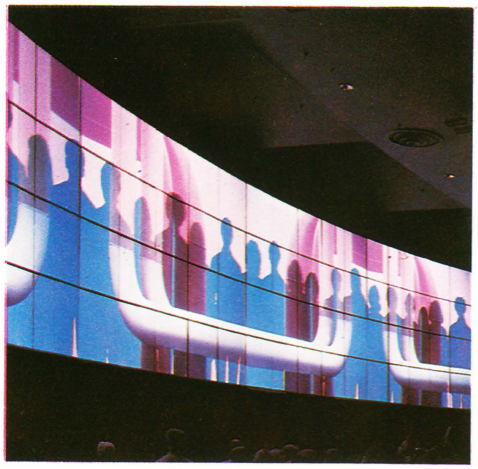
PROCEDURE

1) Teachers may want to review the following vocabulary words: energy, fuel, fossils, remains, dinosaurs, electricity, synthetic, nuclear, solar.

2) Place a heavy object on a table in the front of the room. Have several students take turns moving the object to different spots in the room. Explain that when scientists define energy as the ability to do *work*, they mean the ability to *move*.

3) Tell students that they will be reading about energy and that when they are finished, they should be able to tell you at least two facts about energy. Inform students that they will also be responsible for a written worksheet. You may want to review the directions on the worksheet before handing it out.

4) Distribute the materials.



EVALUATION

1) Ask students to recall important points from their reading.

2) Review the answers to the worksheet: 1) a-3, b-1, c-2, d-4; 2) a-M, b-P, c-M, d-M, e-P; 3) c, 4) c, 5) b, 6) a, 7) c, 8) Discuss

SUGGESTIONS FOR FOLLOW-UP ACTIVITIES

1) Title a bulletin board "ENERGY FOR PEOPLE AND MACHINES." Divide the board in half. Label one side "PEOPLE" and the other "MACHINES." Have students draw or cut out pictures of people and the varied foods they eat. Also have them locate pictures of different kinds of machines and their sources of energy. Let students help affix the pictures on the correct half of the board. Use colored strands of yarn and ask students to attach them from people and machines to the corresponding energy source.

2) Stimulate writing and divergent thinking about energy by asking each student to describe an extremely heavy, mysterious package. Then have students list fifteen different ways to move the box from one place to another.

3) Younger students are fascinated by dinosaurs. They may tell the story of fossil fuels in several ways: by dramatization, with painting, by constructing dioramas (perhaps including their favorite toy dinosaurs), writing songs, and more. Be sure that students mention the current problem with fossil fuels—their diminishing supply.

Universe of Energy

Energy is the ability to do work. For people to work, their bodies must change food into energy. Machines also need energy to work. Fuel is something that is used to create energy, usually by burning. Food is the fuel that the human body uses to get energy. But machines use other fuels to get their energy. Most of the energy used by machines and people began with the sun.

Plants use the sun's rays to grow. They also store some of the sun's energy. People and other animals eat the plants, or the meat of animals who have eaten plants. In this way, the energy stored by the plants is given to animals. Plants and animals have been getting energy from the sun in this way for millions of years.

Fossils are the hardened remains of plants and animals that lived long ago. Fossil fuels are the fuels formed from the remains of plants and animals that lived when dinosaurs walked the earth. Coal, gas and oil are fossil fuels. They contain the stored-up energy of the sunshine that fell on plants and animals hundreds of millions of years ago. This is why fossil fuels are sometimes called "buried sunshine."

Large amounts of fossil fuels are used every day and some supplies, such as oil and natural gas, are running low. New supplies are often in very hard-to-reach places. Some are even beneath the ocean floor. Oil drilling platforms as big as the Empire State Building are used to bring the oil to the ocean surface.

Scientists are developing other sources of energy for the future. Man-made fuels, called synthetic fuels, can be made from coal, tar sands, or a rock called oil shale.

Electricity is an important energy source. Power plants can use fossil fuels, nuclear energy and even water and wind to generate electricity. Coal, a fossil fuel, is a plentiful fuel for electrical power plants. The United States contains more than one-quarter of the world's coal supply. Nuclear power uses energy stored in tiny particles called atoms to make electricity. Windmills use the energy in the wind. There is also energy in the moving water of rivers. Dams trap that energy and turn it into electricity. In the future, the ocean's waves and tides may be used to create electric power.

Direct use of sunlight is an exciting source of energy. This is called solar energy. At EPCOT Center, the roof of *Universe of Energy* is covered with thousands of solar cells that change sunlight into electricity. These solar cells help power the theatre cars that carry visitors through the showcase.

If people use today's energy sources carefully and also continue to learn about new energy sources, there will be enough energy for the future.

Name_____

Date _____

Number these sentences in the correct order:

1) a) ____ Animals eat plants.
   b) ____ Plants use the sun's energy to grow.
   c) ____ Plants store some of the sun's energy.
   d) ____ Animals use the stored energy of plants.

2) Put a *P* next to the fuels that people use. Put an *M* next to the fuels that machines use.
   a) ____ coal
   b) ____ apples
   c) ____ oil
   d) ____ gas
   e) ____ steak

Underline the correct answer.

3) Which is the best title for the pages you have just read?
   a) The Time When Dinosaurs Walked The Earth
   b) Buried Sunshine
   c) Energy: Yesterday, Today, and Tomorrow
   d) Alternate Energy Sources

4) Fossil fuels are sometimes called "buried sunshine" because
   a) They are very hot.
   b) They can only be found in daylight.
   c) They contain the energy of the sun from millions of years ago.
   d) They are used to make solar cells.

5) A *synthetic* fuel is one that is
   a) from deep below the ocean floor
   b) man-made
   c) plastic
   d) easily burned

6) At EPCOT Center the cars that visitors ride through *Universe of Energy* are partly powered by
   a) solar cells
   b) wood
   c) gas
   d) wind power

7) Nuclear power uses energy stored in
   a) moving air
   b) oceans and tides
   c) atoms
   d) oil shale

8) Many scientists feel that wind power does not make a dependable future energy choice. Can you think why they might say this? Explain here: _____

_____

_____

_____

_____

Instant Lesson Plan: Level B (Grades 7-9)

OBJECTIVES

To define energy
To identify and explain the derivation of fossil fuels
To introduce future energy alternatives
To provide practice in reading comprehension skills

PROCEDURE

1) Teachers may want to review the following vocabulary words: fossil, sediment, compressed, generate, converted, synthetic, remote, yields, controversial, nuclei, hydrogen, helium, geothermal.

2) Ask students if they know what dinosaurs have to do with the cars in which they ride. Accept reasonable answers and then tell students that they will be reading a few pages that will explain the connection. Students should be aware that a written follow-up is required.

3) Distribute the materials.

EVALUATION

Review answers to the worksheet: 1-a, 2-d, 3-b, 4-c, 5-c, 6-a, 7-c, 8-b, 9-Discuss

SUGGESTIONS FOR FOLLOW-UP ACTIVITIES

1) Have students research power blackouts that have occurred in the past. As a class, make a list of all the things that are affected by such a blackout. Then instruct students to compile their own lists of fifty ways of coping with such a blackout. For example, students could include several ways of cooking without electricity. After discussing the feasibility of their ideas, students could illustrate their lists, perhaps creating a compelling bulletin board display.

2) Divide students into small groups to develop energy board games or computer games. The objective of the games would be to reach a destination while overcoming several obstacles, such as running out of fossil fuels, a rainstorm interrupting solar power, a hurricane destroying a windmill, etc. Be sure that students include as many alternative energy sources as possible. These games, of course, will differ greatly according to the sophistication and ability of students.

3) Enlist the aid of the art and science teachers in helping students create "Rube Goldberg-type" models that illustrate what happens when someone uses some type of power. Students could have fun with this project by choosing a unique or humorous end result (i.e., a windmill to blow dry hair, a solar-powered hat, etc.).

Universe of Energy

Energy is the ability to do work. People and machines need energy to work. The human body derives its energy from food. For their power, machines use fuels other than food, such as oil, natural gas, or coal — the fossil fuels.

What are fossil fuels? They are the fuels formed from the remains of long-dead plants and animals. Plants convert the energy of the sun into usable energy by a process known as photosynthesis. Plants use some of this energy for growth, but they also store some. This stored energy is then transferred to animals when they eat the plants — or the meat of other animals who have eaten the plants. When prehistoric animals and plants died, their energy-rich remains were buried by mud, sand, sediment, and compressed into rock. The extreme heat and pressure of the earth gradually changed the remains into natural gas, oil, and coal. It is often said that fossil fuels are the "buried sunshine" of the time when dinosaurs walked the earth.

Increasing amounts of fossil fuels are consumed every day and some supplies, such as oil and natural gas, are running low. The search for new reserves is aided by sophisticated technology, including satellite scans and seismic echo devices. Once located, however, the fuels are often hard to retrieve, requiring the use of gigantic oil drilling platforms.

Scientists are searching for new sources of energy. Synthetic oil is now being produced from tar sands. Some day synthetic oil may fuel our cars and airplanes. Coal can also be converted to synthetic oil and gas. Oil shale, a rock that is plentiful in the United States, can yield vast quantities of oil when it is mined, crushed, and heated.

Another important energy source is electricity. Fossil fuels, or nuclear power, and even wind, water and geothermal energy, can fuel power plants generating electricity. Coal is one of the most plentiful fossil fuel sources for electric power plants. When burned in a boiler, the heat from coal is used to produce steam which then turns a turbine, generating electricity. More than one-quarter of the world's coal reserves are located in the United States, ensuring a long-term supply.

Although controversial, nuclear power is growing in importance as a source of electricity. Within 20 years, nuclear energy may contribute about one-fourth of the world's electricity. When the nuclei of certain atoms are divided, tremendous energy is released. Within the highly-controlled conditions of a nuclear reactor, this atom-splitting process, known as nuclear *fission*, creates heat to generate electricity. Scientists are also experimenting with nuclear *fusion*. When the nuclei of two atoms join, they form a new atom and in this process create an enormous amount of energy. Nuclear fusion occurs naturally on the sun. There, atoms of hydrogen combine to produce helium and the resulting energy lights and warms this entire planet. Scientists are striving to duplicate the same powerful process in a safe, usable way here on earth.

Windmills create electricity from the strong movement of air. Geothermal power plants can generate electricity from steam trapped within the earth. The energy contained in moving water, such as water released from dams, can generate electricity. Someday ocean waves and tides may be used as electric "generators."

Another future energy source, solar energy, comes from sunlight itself. At EPCOT Center, the roof of the *Universe of Energy* contains more than 80,000 solar cells. These cells convert sunlight directly into electricity and help power the moving theatre cars that visitors ride throughout the show.

The road to solving tomorrow's energy needs is long and complex. No single source will supply our future energy demands. With careful use of today's energy resources and the development of new sources for tomorrow, humankind may some day harness the entire "Universe of Energy."

Name_____

Date _____

Underline the correct answers.

1) Fuel is something
   a) used to produce energy
   b) in liquid form
   c) only used in the last 20 years
   d) cannot be man-made

2) Which of these are used as fuels?
   a) coal
   b) wood
   c) milk
   d) all of the above
   e) none of the above

3) Photosynthesis is a process by which
   a) dinosaurs stalked their prey
   b) plants convert the sun's energy into usable energy
   c) fossil fuels were formed
   d) none of the above

4) Remains of prehistoric plants and animals were changed into fossil fuels by
   a) the sun
   b) volcanic eruptions
   c) extreme heat and pressure
   d) photosynthesis

5) When something is *synthetic*, it is
   a) made of plastic
   b) inexpensive
   c) man-made
   d) unbreakable

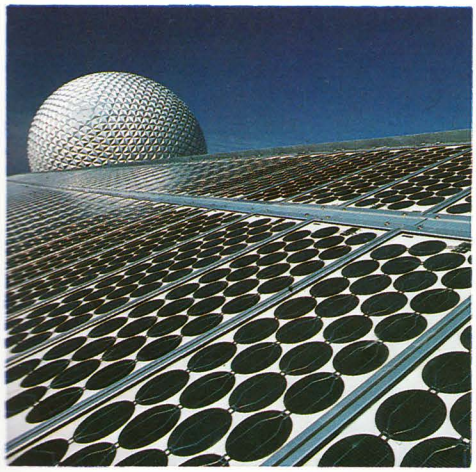
6) Electricity generated from steam trapped within the earth is known as
   a) geothermal power
   b) wind power
   c) geyser fuel
   d) hydroelectric power

7) The sun's enormous energy is a result of
   a) sunspots
   b) gravity
   c) nuclear fusion
   d) nuclear fission

8) *Universe of Energy* at EPCOT Center provides a living, working demonstration of
   a) coal-mining
   b) solar power
   c) nuclear fission
   d) none of the above

9) Which of the alternate energy sources mentioned in these pages do you think will greatly change your life 25 years from today? Use the back of this paper to explain.

Instant Lesson Plan: Level C (Grades 10-12)



OBJECTIVES

To define energy
To explain the "sun-plant-animal" energy chain
To identify fossil fuels
To introduce alternate sources of energy for the future
To provide practice in reading comprehension skills

PROCEDURE

1) Write the word *energy* on the board. Explain that students will be reading a handout that contains many basic facts about energy. Tell students that they should be able to recall at least three of these facts when they have finished the reading. Also let students know that a written worksheet will follow.

2) Distribute the materials.

EVALUATION

1) Ask several students to recall one or more of the important points from their reading.

2) Review answers to the worksheet: 1-b, 2-c, 3-a, 4-c, 5-a, 6-d, 7-d, 8-c, 9-Discuss

SUGGESTIONS FOR FOLLOW-UP ACTIVITIES

1) Divide students into small groups to design and build models of "dream houses" operated by alternate energy sources. Have students create moving, working parts when possible. For example, a simple solar battery might power a child's outdoor merry-go-round. Encourage students to divide labor in a way that makes best use of the talents of each member of the group. Some students may do the rough draft, some the actual construction, and others may create a clever advertisement that explains the energy benefits of their "dream house".

2) After research, have students debate the issues regarding nuclear energy and the disposal of nuclear waste. Invite two experts supporting each position to answer questions after the debate. Before and after the debate, poll student opinions. Chart the results and discuss any changes.

3) What kinds of cars will your students be driving in twenty years? What kind of fuel will they be using for these cars? Divide the class into groups. Have each group develop a car magazine of the future. The magazine should include feature articles, interviews with experts, futuristic ads for new cars, and more.

Universe of Energy

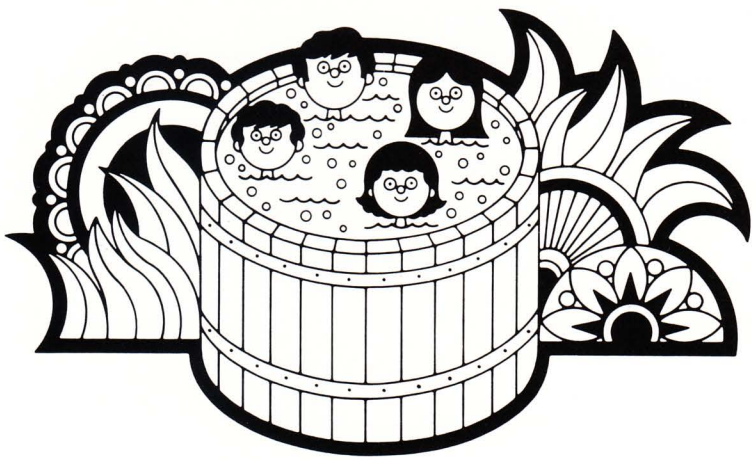
Energy is the ability to do work. People and machines need energy to work. One very complex machine, the human body, derives its energy from food. Through photosynthesis, plants convert the energy of the sun into chemical energy. Some of this energy is used for growth, but much of it is stored in the plant cells. Once people digest the plants (or the meat of other animals who have eaten the plants), their muscles can change the chemical energy into *kinetic* energy, the energy of motion. Thus humans, and other animals, are able to move — or, in terms of physical science, to *work*. For their movement, inanimate machines depend on fuels other than food, such as coal, natural gas, and oil — the fossil fuels. The fossil fuels were created from the remains of prehistoric plants and animals who received their energy in the same "sun-plant-animal" chain. For this reason, the fossil fuels are often referred to as "buried sunshine."

In the past, sources of fossil fuels were plentiful and inexpensive. However, as the demand for energy has increased, fossil fuel supplies have become increasingly expensive and difficult to obtain. At one time, enough fossil fuels could be produced domestically, but now oil and natural gas must be imported from foreign countries as well.

The need to reduce foreign importation and higher costs of fossil fuels have stimulated people to conserve energy. Conservation can be thought of as anything which helps to use less energy, or uses energy more efficiently. Some examples are the insulating of buildings to reduce heating and cooling requirements, and the development of automobile motors which use less fuel.

Even with conservation, the demand for energy has continued to grow, resulting in the search for additional fossil fuel reserves. Exploration for oil and natural gas has intensified, particularly in the Arctic region and ocean waters. This renewed effort is aided by sophisticated technology including satellites, seismic echo devices, and computers.

Much attention is now being paid to the development of alternate fuels which, in the long term, will add to our diminishing natural reserves. Already, synthetic oil can be produced from coal, tar sands, oil shale and even certain plants such as corn and water hyacinths. Scientists are currently working to lower the cost of synthetic oil production for wide-scale use.



The search for a better energy future must include resources such as solar, geothermal and wind. Solar energy, the energy contained in sunlight, can be used both for direct heating and the production of electricity. The sun's energy can heat and cool buildings as well as provide hot water for inhabitants. Another promising use of solar energy is photovoltaics — the direct conversion of sunlight into electricity. At EPCOT Center, the roof of *Universe of Energy* contains more than 80,000 solar cells which help power the moving theatre cars throughout the show.

Geothermal energy is already a reality in several locations around the world. Water from below the earth's surface provides direct heating and, in some instances, produces electricity.

At one time, windmills abounded both in Europe and the United States, harnessing the wind's energy to pump water and grind grain. Today, modern windmills are streamlined machines which contribute to the electrical supply.

No single source can provide all of our future energy needs. Careful use of current resources, coupled with the innovative development of new sources, can eventually harness the entire "Universe of Energy."

Significant sources for generating electricity over the near term include: coal (a fossil fuel) and nuclear and hydropower (both non-fossil fuels). Over one-quarter of the world's supply of coal is located in the United States, ensuring a substantial source for electrical plants. Environmental problems associated with the mining, transportation and burning of coal are currently being resolved in order to realize the vast potential of this plentiful fuel.

Nuclear power also provides a significant contribution to generating electricity. Present-day technology uses nuclear *fission*. In this process, the nuclei of uranium atoms are split, releasing enormous amounts of energy. The resulting heat boils water, producing steam which is then used to generate electricity. Scientists are also hard at work on an opposite nuclear process called *fusion*. In fusion, the nuclei of hydrogen atoms are joined together creating even more energy than fission. As in the case of coal, environmental problems and questions of health and safety are associated with nuclear power, posing one of man's greatest challenges today.

Although limited in its availability, hydropower is an important source of energy. The most common example of hydropower is dams which use the energy contained in moving water to produce electricity. Water stored behind the dam is released through tunnels containing turbines. As the turbine turns by the force of the water, electricity is generated. Energy technology, utilizing ocean waves and even tides, can also provide usable energy.

Name_____

Date _____

Underline the correct answers.

1) Muscles transform chemical energy into
   a) physical energy
   b) kinetic energy
   c) calories
   d) fat

2) In the definition of energy, to "work" means
   a) to get a job
   b) to exercise
   c) to move
   d) to heat

3) Fossil fuels are called "buried sunshine" because
   a) they contain energy stored from the sun millions of years ago
   b) are usually golden in color
   c) are used to light buildings through electricity
   d) all of the above

4) One-quarter of the world's supply of _____ is in the United States.
   a) natural gas
   b) oil
   c) coal
   d) solar energy

5) When the price of energy increases people will tend to
   a) use less
   b) use more
   c) use the same amount
   d) none of the above

6) Synthetic fuels are being produced from
   a) tar sands
   b) oil shale
   c) plants
   d) all of the above

7) Electricity can be produced from
   a) coal
   b) nuclear
   c) hydropower
   d) all of the above

8) The direct conversion of sunlight into electricity is called
   a) fission
   b) fusion
   c) photovoltaics
   d) none of the above

9) Which of the alternate energy sources mentioned in these pages do you think will greatly change your life 25 years from today? Use the back of this paper to explain.

10) ON the back of this paper list *two* future alternate energy sources and explain what you believe to be the advantages and disadvantages of each.

EPCOT EDUCATIONAL MEDIA

A new dimension in educational media

This Teacher's Guide to EPCOT Center is just a beginning . . . Now you can bring more of the compelling ideas and concepts of EPCOT Center right to your classroom with exciting new EPCOT Educational Media. Through a range of innovative media, designed for all grade levels, you'll be able to explore vital topics with your students and develop skills essential to their future success. Help your students to be prepared for tomorrow's changes in our increasingly technological world!

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